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(11) EP 1 078 977 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.02.2001 Bulletin 2001/09

(21) Application number: 99306079.7

(22) Date of filing: 30.07.1999

(51) Int Cl.7: C10M 141/06, C10M 163/00
// (C10M141/06, 129:76, 133:16,
133:56),
(C10N30/00, 30:12, 40:08,
40:12)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

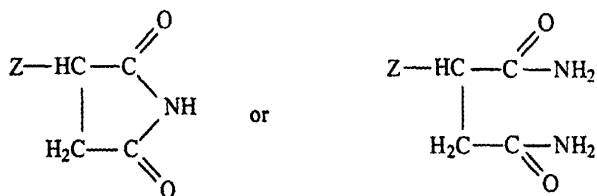
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(54) LUBRICANT COMPOSITIONS

(57) A lubricant composition comprising a base oil, a rust inhibitor system comprising (A) at least one neutral rust inhibitor and (B) a compound of formula:



in which Z is a group $\text{R}_1\text{R}_2\text{CH}-$, in which R_1 and R_2 are each independently hydrocarbyl groups containing up to 34 carbon atoms, the total number of carbon atoms in the groups R_1 and R_2 being from 11 to 35, and (C) a solubilising agent for the rust inhibitor system which is an ashless dispersant.

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Description

[0001] The present invention relates to lubricating compositions which exhibit good rust inhibition and wet filterability and to their use.

5 [0002] Fluids/lubricants for turbine ("R&O"), hydraulic and industrial applications are required to meet a variety of performance characteristics and these tend to be achieved by blending an additive/additive pack with a base oil. The additive/additive pack imparts the desired properties to the base oil thereby making it suitable for its intended utility.

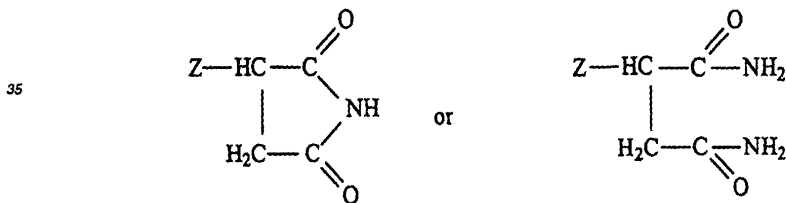
[0003] Rust inhibition is a property which is often desired, particularly in hydraulic fluids and turbine oils, and numerous additives have been used to achieve this. Recent attention in this regard has been upon acidic rust inhibitors such as reaction products of carboxylic acids, polyalkylene polyamines and alkenyl succinic anhydrides such as are described in USP 4,101,429. Unfortunately, while these acidic rust inhibitors can give the desired level of rust inhibition, in the presence of water they tend also to interact with metals which may be present either deliberately, in the form of other functional additives components such as metal-containing detergents, or as contaminants. This interaction can lead to the production of degradation products leading to deposit formation as particulates and/or precipitates. In hydraulic fluids the degradation products are particularly troublesome because to maintain good power transmission and to avoid damaging hydraulic equipment in which they are used, the hydraulic fluid should be kept meticulously clean and free of contaminants. To ensure that the fluid is substantially free of contaminants very fine filters are used. However, the kind of degradation products which are produced can result in filter clogging or blocking.

[0004] Turbine oils represent another practical situation where the cleanliness of the lubricant (R&O oil) used is important. To maintain effective operating conditions and to avoid damaging the equipment in which they are used turbine oils should be kept meticulously clean and free of contaminants. Again, very fine filters are used to minimize contamination.

[0005] The present invention provides a lubricant composition which exhibits rust performance comparable to compositions based on the kind of acidic rust inhibitors mentioned above, and which do not interact adversely with metal (s) which are present in the formulated lubricant, especially when water is also present, i.e. the compositions exhibit good wet filterability. It is also desirable to provide a rust inhibitor system which has good solubility in a variety of oil basestocks. The present invention also satisfies this criterion.

[0006] Accordingly, the present invention provides a lubricant composition comprising a base oil, a rust inhibitor system comprising (A) at least one neutral rust inhibitor and (B) a compound of formula:

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in which Z is a group $\text{R}_1\text{R}_2\text{CH}-$, in which R_1 and R_2 are each independently hydrocarbyl groups containing up to 34 carbon atoms, the total number of carbon atoms in the groups R_1 and R_2 being from 11 to 35, and (C) a solubilising agent for the rust inhibitor system which is an ashless dispersant.

45 [0007] The term "neutral rust inhibitor", in the present specification, means a rust inhibitor that is essentially free of -COOH functional groups.

[0008] Preferably, the at least one neutral rust inhibitor is a hydrocarbyl ester of formula $\text{R}(\text{COOR}')_n$, in which R and R' are each independently hydrocarbyl or hydroxyhydrocarbyl groups containing up to about 40 carbon atoms and n is from 1 to 4.

50 [0009] Preferably, in the hydrocarbyl ester (A) R and R' are each independently hydrocarbyl groups, or hydroxyhydrocarbyl groups, containing 8 to 20 carbon atoms, and n is from 1 to 4.

[0010] It will be appreciated that the maximum number of groups COOR' which are present on the hydrocarbyl or hydroxyhydrocarbyl group R will vary depending on the number of carbon atoms in R. For example, if R is a hydrocarbyl group containing only one carbon atom, the maximum possible value of n will be 4. When R is a hydroxyhydrocarbyl group containing one carbon atom the maximum value of n will be 3.

55 [0011] The hydrocarbyl esters can be prepared by conventional esterification procedures from a suitable alcohol and an acid, acid halide, acid anhydride or mixtures thereof. Also, the esters of the invention can be prepared by conventional methods of transesterification. By "essentially free", it is meant that the starting acids, acid halides, acid anhy-

driles or mixtures thereof used in preparing the hydrocarbyl esters are reacted with an amount of alcohol sufficient to theoretically convert all of the -COOH groups to esters. Typically, the ester will have a TAN of less than 10mgKOH/g. Preferred esters include, but are not limited to, octyloleoyl malate, dioleoyl malate, pentaerythritol monooleate and glycerol monooleate. Of these the use of pentaerythritol monooleate is more preferred.

5 [0012] Another class of preferred neutral rust inhibitors includes aspartic acid diesters of 1-(2-hydroxyethyl-2-heptadecenyl)-imidazoline. This imidazoline is primarily a mixture of diester of L-aspartic acid and an imidazoline based on the reaction between oleic acid and ethanolamine. Esters of this type are commercially available from Mona Industries, Inc. as Monacor[®] 39.

10 [0013] In the compounds (B) the radical Z may be, for example, 1-methylpentadecyl, 1-propyltridecenyl, 1-pentyltridecenyl, 1-tridecenylpentadecenyl or 1-tetradecyleicosenyl. Preferably, the number of carbon atoms in the groups R₁ and R₂ is from 16 to 28 and more commonly 18 to 24. It is especially preferred that the total number of carbon atoms in R₁ and R₂ is about 20 to 22. The preferred compound (B) is a 3-C₁₈₋₂₄ alkenyl-2,5-pyrrolidindione, i.e. a compound in which the average number of carbon atoms in the alkenyl group is from 18 to 24.

15 [0014] In one aspect of the invention, the compound (B) has a titratable acid number (TAN) of about 80 to about 140 mgKOH/g, preferably about 110mgKOH/g. The TAN is determined in accordance with ASTM D 664.

[0015] The compounds (B) are commercially available or may be made by the application or adaptation of known techniques (see for example EP-A-0389237).

20 [0016] Component (C) is an ashless dispersant. Many types are known and any of these is believed to be useful in practice of the present invention. Thus, the ashless dispersant may be a hydrocarbyl succinimide, i.e. the reaction product of a polyamine, such as a polyalkylene polyamine, and a hydrocarbyl succinic acylating agent. The term "succinimide" is intended to encompass compounds which many have an amide, amidine and/or salt linkage in addition to the imide linkage that results from the reaction mentioned. Of the succinimides, preferred are those in which one of the reactants is an aliphatic hydrocarbyl substituted succinic acylating agent in which the hydrocarbyl moiety contains at least 40 carbon atoms. Typically, the hydrocarbyl moiety is derived from a polyalkene. Useful polyalkenes normally have a number average molecular weight of from about 500 to about 10000, for example from about 950 to about 5000. The polyalkene itself may be derived from an ethylenically unsaturated monomer such as ethylene, propylene, 1-butene, isobutene and 1-octene, or polyolefinic monomers such as 1,3-butadiene or isoprene. Preferably, the polyalkene is polyisobutene.

30 [0017] The succinic groups of the acylating agent are usually derived from maleic acid or maleic anhydride or fumaric acid. Thus, in an embodiment of the invention the acylating agent is a polyisobutenyl succinic acid or anhydride.

[0018] The polyalkylene polyamine may be represented by the formula $H_2N(CH_2)_n(NH(CH_2)_m)_mNH_2$ in which n is 2 to about 10 (preferably 2 to 4, most preferably 2) and m is 0 to 10, preferably about 1 to 6. Examples include ethylene diamine, diethylene triamine, triethylene tetramine, tetraethylene pentamine, spermine, pentaethylene hexamine, propylene diamine, butylene diamine, hexamethylene diamine and decamethylene diamine. Mixtures of amines may be used. The use of tetraethylene pentamine, or a mixture of amines which has an overall composition approximating to tetraethylene pentamine, is preferred. Another useful type of polyamine comprises a mixture of acyclic hydrocarbyl polyamines and hydrocarbyl cyclic polyamines. The use of such amines, as well of those mentioned earlier are specifically disclosed in EP-A-0460309. The latter describes useful ashless dispersants of this type and their preparation. Useful dispersants are also commercially available.

40 [0019] Instead of reacting the acylating agent with an amine, useful dispersants may also be formed by reacting the acylating agent with organic hydroxy compounds such as phenols and alcohols, and/or basic inorganic materials. Such dispersants are also well-known in the art (for example, USP 4,466,894).

[0020] In an alternative embodiment, the ashless dispersant may be a so-called "Mannich dispersant". These are the reaction products of alkyl phenols, in which the alkyl group typically contains at least about 30 carbon atoms with aldehydes, especially formaldehyde, and amines, such as polyalkylene polyamines. These dispersants are also well-known in the art (for example, USP 3,413,347, USP 3,697,574, USP 3,725,277, USP 3,725,480 and USP 3,726,882).

45 [0021] In another embodiment, the ashless dispersant may be the reaction product of a high molecular weight hydrocarbyl halide with an amine. These dispersants are known in the art and described in such documents as USP 3,454,555 and USP 5,565,804.

50 [0022] Any of the aforementioned dispersants may be used in post-treated form, that is by subsequent reaction with one or more conventional post-treating agents. Examples of suitable post-treating agent include boron compounds, in greater detail in, for example, EP-A-0460309.

55 [0023] As yet another type of ashless dispersant which may be used, mention may be made of interpolymers of oil-solubilising monomers such as decyl methacrylate, vinyl decyl ether and high molecular weight olefins, with monomers containing polar substituents. These are also known in the art (for example, see USP 3,687,849 and USP 3,702,300).

[0024] In an embodiment of the present invention, the composition further comprises, as component (D), an aliphatic carboxylic acid or anhydride in which the aliphatic group contains at least 20 carbon atoms. The group typically includes

upto about 500 carbon atoms, preferably from about 10 to about 300 carbon atoms and often from about 10 to about 150 carbon atoms. For instance, component (D) may be an aliphatic substituted succinic anhydride or acid containing from about 20 to about 500 carbon atoms in the aliphatic substituent, preferably from about 30 to about 300 carbon atoms, and often from about 50 to about 150 carbon atoms. Patents describing useful aliphatic carboxylic acids or anhydrides and methods for preparing them include USP nos. 3,215,707, 3,219,666, 3,231,587, 3,912,764, 4,110,349 and 4,234,435 and GB 1,440,219.

[0025] In an embodiment of the invention component (D) is an alkenyl carboxylic acid or anhydride in which the alkenyl group contains from 10 to 75 carbon atoms, preferably an alkenyl succinic anhydride in which the alkenyl group contains from 10 to 65 carbon atoms. In this embodiment component (D) may be a polyisobutenyl succinic anhydride in which the polyisobutenyl moiety has a number average molecular weight of about 300 to about 950. It has been found that component (D) provides further advantages in terms of component solubility.

[0026] As referred to herein, number average molecular weight is determined by mass spectral analysis.

[0027] Unless otherwise stated all hydrocarbyl groups and moieties may be straight- or branched-chain.

[0028] In an embodiment of the invention, the compositions are substantially free of acidic rust inhibitors and/or metal detergents. For the purposes of the present invention, the term "substantially free" means that no acidic rust inhibitors or metal, for example as metal-containing detergent, are purposefully added to the finished oil although there may be some present due to contamination or as an impurity.

[0029] Lubricating oils contemplated for use in this invention include natural lubricating oils, synthetic lubricating oils and mixtures thereof. Suitable lubricating oils also include basestocks obtained by isomerization of synthetic wax and slack wax, as well as basestocks produced by hydrocracking (rather than solvent extracting) the aromatic and polar components of crude oil. In general, both the natural and synthetic lubricating oils will each have a kinematic viscosity ranging from about $1 \times 10^{-6} \text{ m}^2/\text{s}$ to about $40 \times 10^{-6} \text{ m}^2/\text{s}$ (about 1 to about 40 cSt) at 100°C , although typical applications will require each oil to have a viscosity ranging from about $2 \times 10^{-6} \text{ m}^2/\text{s}$ to about $8 \times 10^{-6} \text{ m}^2/\text{s}$ (about 2 to about 8 cSt) at 100°C .

[0030] Natural base oils include animal oils, vegetable oils (e.g., castor oil and lard oil), petroleum oils, mineral oils, and oils derived from coal or shale. The preferred natural base oil is mineral oil.

[0031] The mineral oils useful in this invention include all common mineral oil base stocks. This would include oils that are naphthenic or paraffinic in chemical structure. Oils that are refined by conventional methodology using acid, alkali, and clay or other agents such as aluminum chloride, or they may be extracted oils produced, for example, by solvent extraction with solvents such as phenol, sulfur dioxide, furfural, dichloroethyl ether, etc. They may be hydrotreated or hydro-refined, dewaxed by chilling or catalytic dewaxing processes, or hydrocracked. The mineral oil may be produced from natural crude sources or be composed of isomerized wax materials or residues of other refining processes.

[0032] Typically the mineral oils will have kinematic viscosities of from $2 \times 10^{-6} \text{ m}^2/\text{s}$ to $12 \times 10^{-6} \text{ m}^2/\text{s}$ (2 cSt to 12 cSt) at 100°C . The preferred mineral oils have kinematic viscosities of from $3 \times 10^{-6} \text{ m}^2/\text{s}$ to $10 \times 10^{-6} \text{ m}^2/\text{s}$ (3 to 10 cSt), and most preferred are those mineral oils with viscosities of $5 \times 10^{-6} \text{ m}^2/\text{s}$ to $9 \times 10^{-6} \text{ m}^2/\text{s}$ (5 to 9 cSt) at 100°C .

[0033] Synthetic lubricating oils useful in this invention include hydrocarbon oils and halo-substituted hydrocarbon oils such as oligomerized, polymerized, and interpolymerized olefins [e.g., polybutylenes, polypropylenes, propylene, isobutylene copolymers, chlorinated polybutylenes, poly(1-hexenes), poly(1-octenes), and mixtures thereof]; alkylbenzenes [e.g., polybutylenes, polypropylenes, propylene, isobutylene copolymers, chlorinated polybutylenes, poly(1-hexenes), poly(1-octenes) and mixtures thereof]; alkylbenzenes [e.g., dodecyl-benzenes, tetradecylbenzenes, di-nonylbenzenes and di(2-ethylhexyl)benzene]; polyphenyls [e.g., biphenyls, terphenyls, alkylated polyphenyls]; and alkylated diphenyl ethers, alkylated diphenyl sulfides, as well as their derivatives, analogs, and homologs thereof, and the like. The preferred synthetic oils are oligomers of α -olefins, particularly oligomers of 1-decene, also known as polyalphaolefins or PAOs.

[0034] Synthetic lubricating oils also include alkylene oxide polymers, interpolymers, copolymers, and derivatives thereof where the terminal hydroxyl groups have been modified by esterification or etherification. This class of synthetic oils is exemplified by: polyoxyalkylene polymers (e.g., methylpolyisopropylene glycol ether having an average alkyl and aryl ethers of these polyoxyalkylene polymers (e.g., methylpolyisopropylene glycol having an average molecular weight of 1000, diphenyl ether of polypropylene glycol having a molecular weight of 100-1500); and mono- and poly-carboxylic esters thereof (e.g., the acetic acid esters, mixed $\text{C}_3\text{-C}_8$ fatty acid esters, and C_{12} oxo acid diester of tetraethylene glycol).

[0035] Another suitable class of synthetic lubricating oils comprises the esters of dicarboxylic acids (e.g., phthalic acid, succinic acid, alkyl succinic acids and alkenyl succinic acids, maleic acid, azelaic acid, suberic acid, sebacic acid, fumaric acid, adipic acid, linoleic acid dimer, malonic acid, alkylmalonic acids and alkenyl malonic acids) with a variety of alcohols (e.g., butyl alcohol, hexyl alcohol, dodecyl alcohol, 2-ethylhexyl alcohol, ethylene glycol, diethylene glycol, monoethers and propylene glycol). Specific examples of these esters include dibutyl adipate, di(2-ethylhexyl) sebacate, di-n-hexyl fumarate, dioctyl sebacate, diisooctyl azelate, diisodecyl azelate, dioctyl isophthalate, didecyl phthalate,

dieicosyl sebacate, the 2-ethylhexyl diester of linoleic acid dimer, and the complex ester formed by reacting one mole of sebacic acid with two moles of tetraethylene glycol and two moles of 2-ethyl-hexanoic acid. A preferred type of oil from this class of synthetic oils are adipates of C_4 to C_{12} alcohols.

[0036] Esters useful as synthetic lubricating oils also include those made from C_5 to C_{12} monocarboxylic acids and polyols and polyol ethers such as neopentyl glycol, trimethylolpropane pentaerythritol, dipentaerythritol and tripentaerythritol.

[0037] Silicon-based oils (such as the polyalkyl-, polyaryl-, polyalkoxy-, or polyaryloxy-siloxane oils and silicate oils) comprise another useful class of synthetic lubricating oils. These oils include tetra-ethyl silicate, tetraisopropyl silicate, tetra-(2-ethylhexyl) silicate, tetra-(4-methyl-2-ethylhexyl) silicate, tetra-(p-tert-butylphenyl) silicate, hexa-(4-methyl-2-pentoxy)-disiloxane, poly(dimethyl)-siloxanes and poly (methylphenyl) siloxanes. Other synthetic lubricating oils include liquid esters of phosphorus containing acids (e.g., tricresyl phosphate, trioctylphosphate, and diethyl ester of decylphosphonic acid), polymeric tetrahydrofurans and poly- α -olefins.

[0038] The lubricating base oils may be derived from refined, re-refined oils, or mixtures thereof. Unrefined oils are obtained directly from a natural source or synthetic source (e.g., coal, shale, or tar sands bitumen) without further purification or treatment. Examples of unrefined oils include a shale oil obtained directly from an esterification process, each petroleum oil obtained directly from distillation, or an ester oil obtained directly from a retorting operation, a which is then used without further treatment. Refined oils are similar to the unrefined oils except that refined oils have been treated in one or more purification steps to improve one or more properties. Suitable purification techniques include distillation, hydrotreating, dewaxing, solvent extraction, acid or base extraction, filtration, and percolation, all of which are known to those skilled in the art. Re-refined oils are obtained by treating used oils in processes similar to those used to obtain the refined oils. These re-refined oils are also known as reclaimed or reprocessed oils and are often additionally processed by techniques for removal of spent additives and oils breakdown products. White oils, as taught in U.S. 5,736,490 may also be used as the base oil, especially for turbine applications.

[0039] Another aspect of the invention concerns the solubility of the active components of the lubricant compositions in a variety of types of base oil. In fact, it is believed that the ashless dispersant (C) and, where present, compound (D) are responsible for the enhanced solubility of the rust inhibitor system, especially in hydroprocessed basestocks with reduced aromaticity and thus reduced solvency. One consequence of enhanced additive solubility is improved filterability. The invention also provides use of the ashless dispersant (C) and, optionally, compound (D) to improve aesthetic appearance of a base oil comprising the rust inhibitor system on contamination with water.

[0040] Original equipment manufacturers are constantly striving for increased lubricant performance yet environmental constraints pressure lubricant formulation. As a consequence, one important change facing the industrial lubricant industry will be the increased availability of hydrocracked and catalytically dewaxed base oils suitable for turbine, hydraulic and industrial oil applications. The hydrogenation and dewaxing operations can result in base oils of exceptionally low aromaticity and sulfur level, and this can influence the solubility and thus the performance of lubricant additives used in these base oils. The additive components (A) and (B) when used with component (C) and, when used (D), exhibit good solubility over a range of base oil types, more particularly Group I, Group II, Group III and Group IV basestocks, and therefore offer advantages in terms of formulation flexibility.

[0041] The American Petroleum Institute has categorized these different basestock types as follows: Group I, >0.03 wt% sulfur, and/or <90 vol% saturates, viscosity index between 80 and 120; Group II, ≤ 0.03 wt% sulfur, and ≥ 90 vol% saturates, viscosity index between 80 and 120; Group III, ≤ 0.03 wt% sulfur, and ≥ 90 vol% saturates, viscosity index >120 ; Group IV, all polyalphaolefins. Hydrotreated basestocks and catalytically dewaxed basestocks, because of their low sulfur and aromatics content, generally fall into the Group II and Group III categories. Polyalphaolefins (Group IV basestocks) are synthetic base oils prepared from various alpha olefins and are substantially free of sulfur and aromatics.

[0042] The lubricant composition of the present invention may be prepared by simple blending of the various components with a suitable base oil.

[0043] For the sake of convenience, and in another embodiment of the present invention, the additive components used in practice of this invention may be provided as a concentrate for formulation into a lubricant composition ready for use. The concentrate may comprise, in addition to the various components, a solvent or diluent for the fluid components. The solvent or diluent should be miscible with and/or capable of dissolving in the base oil to which the concentrate is to be added. Suitable solvents and diluents are well known. The solvent or diluent may be the base oil of the lubricating oil composition itself. The concentrate may suitably include any of the conventional additives used in lubricating oils compositions. The proportions of each component in the concentrate are controlled by the intended degree of dilution, though top treatment of the formulated fluid is possible.

[0044] Whether added directly to the base oil, or in the form of a concentrate, the weight ratio of components (A): (B) is usually from 3:1 to 8:1, preferably 4:1 to 6:1. The total amount of (A) and (B) should be present in the finished oil in an amount of 0.15 to 0.5% by weight, preferably from 0.20 to about 0.4% by weight. The weight ratio of [(A)+(B)]: (C) is usually 7.5:1, in the concentrate or finished oil. The total amount of (C) in the finished oil is usually 0.03% by

weight. Whether added directly to the base oil, or in the form of a concentrate, component (D), should be present in the finished oil in an amount of 0.01 % by weight. The amounts (A), (B), (C) and, where used, (D) in a concentrate are such that the amounts mentioned should be achieved in the finished composition when the concentrate is used at typical treat rates of, for instance, 0.30% by weight.

5 [0045] Other additives commonly used in lubricants/fluids for turbine, hydraulic and industrial applications may be included in the compositions or concentrates of the present invention. These include antiwear agents, such as sulphur and/or phosphorus containing compounds, antioxidants, demulsifiers and corrosion inhibitors. These additives, when present, are used in amounts conventionally used in such applications. Some additives may be included in the concentrate and some added to the fully formulated lubricant/fluid as a top-treat.

10 [0046] The invention will now be illustrated by the following Examples that are not intended to limit the scope of the invention in any way.

EXAMPLES

15 [0047] Lubricant fluid compositions were prepared in accordance with the following table. The amounts given for each component are expressed as percentage by weight of component in an additive concentrate. The treat rate indicates the level of dilution of the concentrate in formulating the composition.

[0048] The compatibility of the additive components in the compositions was assessed visually after one month.

20 [0049] The wet filtrability of each fluid was assessed using Afnor E48-691 (wet) test. In the latter a water-treated fluid is filtered under conditions of constant pressure and temperature through a membrane with a determined absolute stopping power.

[0050] The filtrability index of the fluid IF is defined for a given fluid by the ratio:

$$25 \quad IF = \frac{T_{300} - T_{200}}{2 (T_{100} - T_{50})}$$

in which

30 T_{300} is the passage time, through the membrane, of 300 cm³ of fluid.

T_{200} is the passage time, through the membrane, of 200 cm³ of fluid.

T_{100} is the passage time, through the membrane, of 100 cm³ of fluid.

T_{50} is the passage time, through the membrane, of 50 cm³ of fluid.

35 [0051] The IF ratio therefore consists of comparing the filtration speeds of the fluid in the course of the test. The ratio as well as the filtration speed of the various segments for each sample are indicative of the ease of filtration of the fluid. An IF value of less than 1 indicates a fault in the test method. The closer the IF value to 1, the better filtrability of the fluid. If during testing the membrane becomes clogged an abort result is recorded.

40 [0052] The Shell Filtration Test is used to evaluate the filterability characteristics of oil based hydraulic fluids with and without calcium and/or water contamination. The fluids as blended and the contaminated fluids are each tested in duplicate as follows. After pre-treatment at 70°C, 300 ml of test oil are filtered through a 1.2 micron Millipore membrane using a 650 mm Hg vacuum. The fluid temperature is not specifically controlled but should be in the range of 19 to 26°C. The time in seconds for each successive 100 ml of fluid to filter, or for the filter membrane to block, are noted. The results of the Shell Filtration Test are indicated as either PASS, meaning that all 300 ml of oil passed through the filter, or FAIL, meaning that the filter became blocked.

45 [0053] The tendency of the hydraulic fluid to cause rusting was assessed during the ASTM D665B test. In this test a steel blank is cleaned by rotation at 1700 rpm in contact with 150 grade aluminium oxide cloth and then with 280 grade cloth. A PTFE holder is attached to the blank and this assembly completely immersed in a test tube containing the fluid under test. 300 ml of test fluid is poured into a 400 ml beaker, the beaker having been cleaned first using detergent solution, rinsed with distilled water and dried in an oven for about 15 minutes. The beaker is then placed in
50 an oil bath (set to 60°C) to which a perspex cover is attached. A stirrer is lowered into the test fluid through a hole in the top of the cover and the fluid stirred. After about 30 minutes the steel blank is removed from the test tube and allowed to drain briefly before placing into the beaker. After a further 30 minutes, 30 ml of synthetic sea water solution is added to the test fluid in the beaker. After 24 hours the steel blank is removed from the test fluid, allowed to drain,
55 rinsed with heptane and assessed according to the following rating system:

PASS : No Rusting

LIGHT : Not more than six rust spots, each of which is less than 1mm in diameter.

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MODERATE : More than six spots, but confined to less than 5% of the surface of the blank.
SEVERE : Rust covering more than 5% of the surface of the blank.

Component (wt%)	Run	
	1	2
A	0.24	0.20
B	0.06	0.05
C	0.05	0.03
D	-	0.01
Treat Rate (%)	0.35	0.3
Base oil (Group)	III	III
Compatability (after 1 month)	clear and bright	clear and bright
Afnor (dry)	1.03	1.03
Afnor (wet)	1.65	1.03
Shell Filtration Test (time in seconds per 100ml) Dry	94/86/87	103/108/111
Wet	PASS (92/103/125)	PASS (101/108/110)
Wet + Ca	PASS (84/91/106)	PASS (106/112/116)
D665B	PASS	PASS

NOTES

Component (A) was pentaerythritol monooleate.

Component (B) was a 3-C₁₈₋₂₄ alkenyl-2,5-pyrrolidindione.

Component (C) was a polyisobutenyl succinimide derived from polyisobutenyl (Mn 1300) succinic anhydride and tetraethylene pentamine.

Component (D) was a polyisobutenyl (Mn 950) succinic anhydride.

[0054] The Group III basestock was Yubase 6.

[0055] The compatibility results show that the additive components remain fully in solution in the basestock used. No precipitate was observed after one month. This confirms that the components exhibit excellent solubility in these refined Group III basestocks. Similar compatability results would be expected in the less severe Group I and II basestocks.

[0056] When Run 1 was repeated except that component (C) was omitted the compatability in the Group III basestock was derated: after 1 month the oil solution was cloudy due to the presence of precipitate. This confirms the efficacy of component (C) in solubilising the rust inhibitor system components.

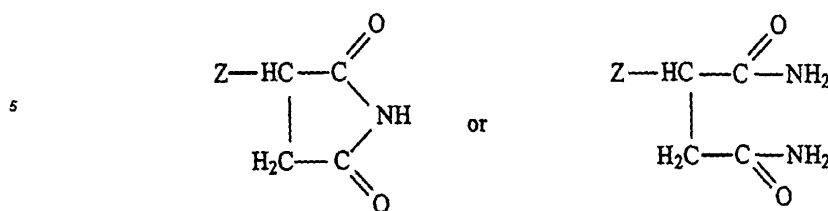
[0057] The Afnor results for Runs 1 and 2 show that the compositions in accordance with the present invention exhibit excellent wet filtrability.

[0058] The results in the Shell Filtration Test show that the compositions exhibit excellent water tolerance, even in the presence of a metal.

[0059] The results in the ASTM D665B rust test are both passing indicating that the composition exhibit acceptable rust inhibiting properties.

Claims

1. A lubricant composition comprising a base oil, a rust inhibitor system comprising (A) at least one neutral rust inhibitor and (B) a compound of formula:



in which Z is a group $\text{R}_1\text{R}_2\text{CH}-$, in which R_1 and R_2 are each independently hydrocarbyl groups containing up to 34 carbon atoms, the total number of carbon atoms in the groups R_1 and R_2 being from 11 to 35, and (C) a solubilising agent for the rust inhibitor system which is an ashless dispersant.

- 15 2. A composition according to claim 1 wherein the at least one neutral rust inhibitor (A) is a hydrocarbyl ester of formula $\text{R}(\text{COOR}')_n$ in which R and R' are each independently hydrocarbyl or hydroxyhydrocarbyl groups containing up to about 40 carbon atoms and n is from 1 to 4.
- 20 3. A composition according to claim 2 wherein R and R' are each independently hydrocarbyl or hydroxyhydrocarbyl groups containing from 8 to 20 carbon atoms.
4. A composition according to claim 3, wherein (A) is pentaerythritol monooleate.
- 25 5. A composition according to any one of the preceding claims, wherein in (B) the total number of carbon atoms in the groups R_1 and R_2 is 18 to 24.
6. A composition according to claim 5, wherein (B) is a 3- C_{18-24} alkenyl-2,5-pyrolidindione.
- 30 7. A composition according to any one of the preceding claims, wherein the ashless dispersant is a Mannich base ashless dispersant.
8. A composition according to any one of claims 1 to 6, wherein the ashless dispersant is the reaction product of polyamine and a hydrocarbyl substituted succinic acylating agent, in which the hydrocarbyl group contains at least 40 carbon atoms.
- 35 9. A composition according to claim 8, wherein the succinic acylating agent is a polyisobutenyl succinic acid or a polyisobutenyl succinic anhydride, derived from polyisobutene having a number average molecular weight of 700 to 5000.
- 40 10. A composition according to claim 8 or 9, wherein the polyamine is an alkylene polyamine of formula $\text{H}_2\text{N}(\text{CH}_2)_n(\text{NH}(\text{CH}_2)_m)_m\text{NH}_2$ in which n is 2 to 10 and m is 0 to 10.
- 45 11. A composition according to claim 10 wherein the polyamine is tetraethylene pentamine or a mixture of polyamines which has an overall composition approximating to tetraethylene pentamine.
12. A composition according to any one of the preceding claims, further comprising (D) an aliphatic carboxylic acid or anhydride in which the aliphatic group contains at least 20 carbon atoms.
- 50 13. A composition according to claim 12, wherein (D) is an alkenyl carboxylic acid or anhydride in which the alkenyl group contains from 10 to 75 carbon atoms.
14. A composition according to claim 13, wherein (D) is an alkenyl succinic anhydride in which the alkenyl group contains from 10 to 65 carbon atoms.
- 55 15. A composition according to claim 14, wherein (D) is a polyisobutenyl succinic anhydride having a number average molecular weight of 300 to 950.
16. A composition according to any one of the preceding claims, wherein the base oil is a Group I, II or III base oil.

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17. A composition according to claim 16, wherein the base oil is a Group II or III base oil.

18. A composition according to any one of the preceding claims further comprising at least one additive selected from antiwear agents, antioxidants, demulsifiers and corrosion inhibitors.

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19. Use of an ashless dispersant (C) as defined in any one of claims 1 and 7 to 11 to improve the solubility in a base oil of a rust inhibitor system comprising a compound (A) as defined in any one of the claims 1 to 3 and a compound (B) as defined in any one of claims 1, 5 and 6.

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20. Use according to claim 19, wherein the ashless dispersant (C) is employed in combination with an aliphatic carboxylic acid or anhydride as defined in any one of claims 12 to 15.

21. Use according to claim 19 or 20, wherein the lubricant composition contains a metal.

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EUROPEAN SEARCH REPORT

Application Number
EP 99 30 6079

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Place of search MUNICH		Date of completion of the search 11 January 2000	Examiner Kazemi, P
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